MULLER 82

The Australasian Expedition to the Muller Range, P.N.G.

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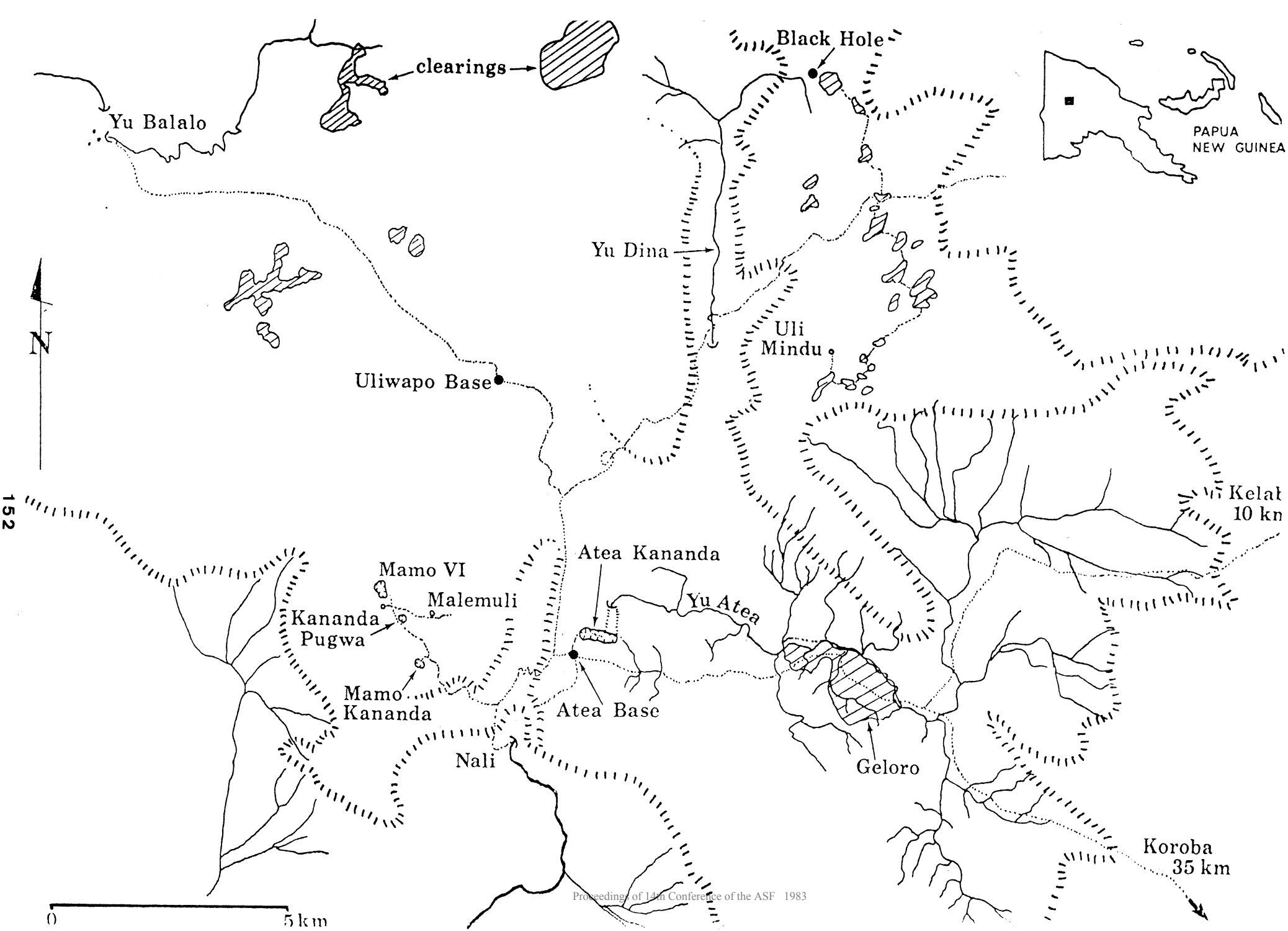
An examination of the results of two months of intensive cave exploration by the fifty-nine participants of the Muller 82 expedition to the karst of the Muller Range, Papua New Guinea.

Several specific aspects of expedition cave surveying and photography are considered in some detail.



The Muller Range in the Southern Highlands of Papua New Guinea was the scene of the successful Australasian expedition, ATEA 78 which explored the now famous Atea Kananda system. When ATEA 78 finished many inviting caves were left incompletely explored or untouched because of the onset of the wet season. Muller 82 was a follow-up expedition which went into the field with a most ambiguous cave exploration programme. One aim was to survey 100km of new passage. To do this initially, Muller 82 had 59 members and 12 Duna tribesmen. These were divided into a number of mini expeditions with widely diverse projects.

Thanks to ATEA 78 the Atea Kananda was already the longest cave in the Southern Hemisphere and subsequent studies had shown where concentrated efforts might increase both its length and depth. The Atea Riverway was a prime objective despite its hazardous nature, even in the so-called "dry" season.

The main base camp would be set up at the ATEA by an advance party but if other areas proved more fruitful the capability existed to deploy the entire resources elsewhere, possibly to the 8km Mamo Kananda. It was only discovered in the last weeks of ATEA 78, and was believed to be a gateway to a vast labyrinth lying below the 100 sq.km Mamo Plateau.

Other objectives were to be undertaken from smaller camps or by mobile groups. The Nali Gorge sported two tantalising entrances high in its walls. Could these provide a backdoor to the Atea Kananda? At Uliwapo and high up in the moss forest of Legari there were unfinished shafts; Uli Mindu where rocks drop for six seconds in silence ... and what of the Black Hole: unvisited, glimpsed only from the air? Perched almost two km vertically above any known risings: could either of these be left unchallenged? Far to the west flows the Yu Balalo, a large river first noticed in 1973 and known to disappear underground. What if this was even more ferocious than the Atea? Could it be explored?

LEGARI - from one Black Hole to another

The airphotos of the Legari Region show alpine clearings, obvious streamsinks, and an impressive black hole at altitudes of 2900m to 3200m. The mountain has 2000m of limestone below it both to the east and west.

Five vertical cavers were set down by helicopter with a month's supplies in a clearing right next to the Black Hole. It did not look right. They could see the bottom only 100m down and that was the end. It was not the "Black Hole" in the MULLER 82 pamphlet! Their main objective had been "explored" in ten minutes between helicopter shuttles and they were isolated with no tracks, 25km and perhaps a week's cutting from anywhere. Serious thought was given to climbing back onto the helicopter and escaping elsewhere, but the Black Hole had not been the only objective.

Uli Mindu was 8km from the dropsite, six of these 8km are through the worst jungle imaginable, so thick that you have to cut track to move. In that 8km are ten streamsinks, which are all completely impassable. Much of the rock is so soft you can cut it with a bushknife. Towards Uli Mindu the limestone looked better, but still they doubted whether there would be any caves larger than the overhang they were living in. The "feeling" was wrong and was not improved when they found Uli Head, one of the most horrible caves on earth. It consistently refused to do the decent thing and finish. Instead this cave spun out for 300 terrible metres attaining a depth of 70m. Their only caving experience was completing the exploration of Uli Mindu. A 150m entrance shaft and a descent through boulders took them to a depth of 200m. Then began a three day hike cross-country to rejoin the other members of the expedition. their jungle walk involved dropping into the Yu Dina valley where for a while they wandered through doline karst with many inviting open shafts, but their food and enthusiasm was rationed, so back to Atea base camp and the real caves.

ATEA KANANDA - a grope in the mud and a fish on the line

The weather conditions on the Muller Plateau during July were ideal for a Riverway push, there was a drought! As soon as the gear arrived at Atea Base Camp the Ship Canal, an 800m swim was rigged with a kilometre of "float rope". The Ducks were found to have some 2m of airspace instead of the 10-20cm familiar to the ATEA 78 cavers. In spite of this the explorers of the regions beyond the Ducks still became nocturnal. If it had not rained during the day they would set out at 9 p.m. in order to get the maximum search time before the possibility of afternoon rain forced a 4 p.m. curfew for the return through the Ducks. The area at the end of the Riverway was given a very systematic going-over but little was found. A last desperate attempt was made by letting a life-lined caver be swept by the full force of the Yu Atea into the Penstock then on a suitable gurgle the strong hauling team would extract him. But he also found nothing. A further 20m of depth was added by a grovel down through the boulders in the floor of Winchester. Thereafter the Riverway became THE tourist trip of the expedition.

The Spanish Inquisition, a connection from New World to the Austral Series was made. At last! There was an alternative to the thixotropic Imperial Mud Standard but it was as easy as its name infers. It was somewhat doubtful if the Spanish Inquisition ever provided faster access to the Silver Hammer Room, another area where depth could possibly be found in the Atea Kananda. There was only one marathon trip to the Austral Series in which the Silver Hammer Room was combed for ways on and down.

The highest part of the Atea Kananda is the Yaragaiya Series and several significant additions were made there. On the first day of the expedition six cavers went into Yaragaiya for a six day camp. After several rather depressing days of crawling into all the leads in the main phreatic maze, systematic exploration back down the Upwapugwa Streamway led into a new higher phreatic level and gave the cave some 39m extra height. When their food supplies were running low the Yaragaiya crew surfaced leaving many leads in this phreatic system. A return was planned, but it was cancelled as enthusiasm for detailed cave exploration diminished with the news reaching Atea from Mamo that cavers were walking through new passage only fifteen minutes from camp rather than after hours of ploughing through Atea mud. The Atea Kananda was left 34.5 km long and 350m deep.

NALI - things that go bump in the night

Out of Yaragaiya and needing a few days in the sun, the underground team rigged a 300m abseil down vertical vegetation to an entrance in the base of the main headwall of the Nali Gorge. The abseil, followed by a scramble down perched vegetation, allowed access to Ngoma Kananda. This cave is an enormous breakdown chamber which makes an excellent campsite if you can tolerate the noise. After dusk when the swiftlets have returned to their roosts by echo location, the fruit bats (flying foxes) begin the night shift, their ghost-like noises occasionally punctuated by the sound of large rocks spontaneously falling out of the roof.

Just along the base of the cliff and around the corner is Pimbiraga Kananda. Behind its railway tunnel entrance is 2.5km of large well decorated passage. Both the Nali caves are believed to be old outflow caves of the Yu Atea but neither has leads in the direction of the Atea Kananda which lies almost directly above. A connection to the Atea Kananda would yield a cave of some 650m deep.

The Nali was again left with entrances still to be explored. The jungle abseil was detackled because the rope was required elsewhere. MULLER 82 had some 4km of rope and there was still a shortage!

ULIWAPO - to bash scrub and bomb shafts

Northeast Mamo was a prime objective of MULLER 82 for it already had Uli Guria (-314m). Left over from 1978 was Uli Eta Riya almost 200m deep and still going. A delightful camp on a stream was created at Uliwapo, a mere 200m from Uli Eta Riya. It would have been closer to the cave but the Duna wanted it where they could fell good firewood straight onto the woodpile. Uli Eta Riya rigged from top to bottom with a continuous length of rope was voted the best vertical cave

on the Muller. Only 200m deep, its floodwashed cream limestone shafts were sheer joy and there was NO MUD!

The Uliwapits stayed on in their luxury surface camp unattracted by the delights being revealed in other places. They revisited Kananda Hiewa Hiea, a 1973 discovery and added another 0.5km of passage in cave that they described as impressive - far more so than its 1973 description indicated. The nine year old foot prints of the original explorers were still stamped in the mud indicating that the cave is not inundated by the huge floods which scour most of the caves on the Muller.

YU BALALO - what's happened to the cavalry?

Uliwapo was also the closest point to Yu Balalo. A helicopter reccé was done to assess the viability of the Yu Balalo and the result was a 30m shaft with a river plunging into it. This got the Uliwapits scrambling northward instead of retreating to southeast Mamo with the rest of the expedition.

After several days of track cutting and traversing rough rocky creekbeds, the barefoot Duna, well out of their known territory were to say the least, unhappy. When the Yu Balalo rose some 5m and began lapping at their campsite their limit had been reached. The food was running low; a strike meeting was held and the decision .... return to Atea! The follow-up party with food and caving equipment met them halfway back to Uliwapo, but it was too late, the Duna were not going back to the Balalo. The wrath of the follow-up party was extreme. It would have been worse if they had seen the promise offered by the Yu Balalo Sink and the huge walk-in entrance two dolines away. With more money all the locating and equipping of the Uliwapits could have been done by helicopter for the reccé helicopter landed in the Yu Balalo streambed right next to the sink. Nevertheless the Yu Balalo system remains as a fantastic project for a future Muller expedition.

ATEA OUTFLOW CAVES - bring your own swingboard

Before the Yu Atea sinks into the Atea Kananda it emerges from nine entrances, the Atea Outflow Caves. These caves have great volumes of water in small passages. In late July the drought broke at precisely the same time as an effort was made to explore the remaining Outflow Caves. The Hydrant is the largest of the caves and was explored in 1978. It has a low flow of 1 m^3 s^{-1}. The small size and smaller flows from the other entrances is deceptive because behind them lies a maze of distributaries with the waters coming from only two sources. The caves containing these have been named Hydrophobia and Hydrocution. There is a connecting passage between the two, making the system over 2km long.

The exploration of these two caves can be summarised as follows: three daring explorers, surveyors and photographers swallowed their hydrophobia long enough to reach the end rockpile by traversing a streamway 1-2m wide and 3m high with some 0.5 $m^3 s^{-1}$ of water in it. On the way out Hydrophobia snapped at two of them and swallowed a third - found him indigestable and spat him out, saving him from severe hydrocution. Hydrocution at the limit of exploration contains about 1 $m^3 s^{-1}$ water flow in a phreatic tube some $3m^2$ and shows evidence of frequent (daily?) flooding but was not fully explored due to severe hydrophobia.

MAMO - Mamo Kananda, 53km of great caving

In "Caves and Karst of the Muller Range" the report of the 1978 expedition, the bold statement had been made that the next expedition was to be "Mamo 82". In effect it was. The whole crew and all the resources of MULLER 82 could have been deployed on Mamo and still not have found all the cave passage that lies beneath this plateau. If this had been done the enormous cost of the expedition would have been considerably reduced.

At first a camp of 10 cavers was established in Mamo Kananda in a delightfully dry sunny entrance discovered in 1978. Considerable effort had gone into the organisation of the available survey data and the information about the 44 possible leads. Exploration began as the

cavers checked off leads from the main dry passage to the deepest point in the cave. They carefully avoided the wet passages which are known to flood to their roof. "What if today is the day the drought breaks?" After two days a new level of passages above Siltstone Blues was discovered containing Roll-a-Go-Go- and Kraftwork. These two main arterial passages were the key to many kilometres of new cave.

Leaptover, a hole between the kitchen table and the food store led to a series of pitches into Siltstone Blues. This gave a route into the cave which only took 15 mins. from the breakfast campfire, from the luxury of pancakes and jam to the frontiers of cave exploration. Two routes into the cave were rigged-down Leaptover which flooded every afternoon sometimes a little, sometimes a lot! 15 minutes through the jungle mud led to the disgustingly muddy MR275 pitch. The preferred route was over Leaptover which avoided the jungle walk and confirms one feature of cave exploration in PNG: that it is frequently faster and always more pleasant to travel underground than on the surface.

One surface exploration priority for the Mamo cavers was to find the "sinking streams". The southeastern fringe of Mamo was considered promising because the dolines are smaller and shallower, several streams appear to collect on siltstone and drain at its edge. Because all the mapping of Mamo has been done by airphoto interpretation there has always been an element of doubt as to whether there would be any surface water courses at all. After 1978 it was felt even more that the sinking streams might just be another cartographers hallucination. To locate the sinking streams was Julia's obsession, little did she know that she had found one in 1978. It was in a doline given the unimaginative name of MR299. This sinking stream was rediscovered by the Mamo cavers and as predicted proved to be the major source of water in Mamo Kananda, leading to a whole set of new entrances. The entrances in turn led to a variety of levels, some old, extremely large and well decorated, others young and exciting vadose streamways.

KANANDA PUGWA - "The Big One"

After the success,the Mamo cavers started to cut track northwest hoping to find a second sinking stream. The very first day brought another success and the second saw them return jubilant after the best days caving of their lives. They had descended a 40m shaft adjacent to the sinking streams and followed a large passage with 50m survey legs all the way, to emerge in the side of a huge chamber (the Departure Lounge) with a massive entrance. This big new cave (Kananda Pugwa) ended in a pitch at the base of an enormous rockpile. The excitement and impulse to explore was contained; the explorers deciding to save this plum for the arrival of the second month team, when a camp would be established in the Departure Lounge. So Kananda Pugwa remained untouched for nearly two weeks during a period of exceptionally dry weather, the irony of which was to be revealed later.

At Mamo Kananda the blistering pace of cave exploration continued. Collapse Scroggin was found and it was the first real indicator that cave passage could extend under the Iquanodon - a huge breakdown chamber. From then on the prospects of depth on Mamo improved.

By the time Kananda Pugwa was occupied Mamo Kananda was 25km long. The pitch at the end of the Departure Lounge was followed through a blowing aperture and down into a dry gypsum covered highway. The air of exploration was invigorating and the explorers raced on, surveying, to a pitch into a sea of darkness. Descending it their highway became an insignificant porthole into Dragons Reach, an even larger collapse chamber. A stream, the size of the sinking stream emerged from a large inlet on one side, flowed around its edge and disappeared over a cliff that conjured up visions of the edge of the world. The survey showed that Dragons Reach was already some 200m below the Mamo datum so Kananda Pugwa was already deeper than Mamo Kananda.

Drawing up surveys on Mamo was never a chore since Sharp Australia donated a Sharp PC1500 portable computer and graphics unit. At the beginning of the expedition the known cave and surface feature on Mamo had been put onto a grid system originating at the Mamo Kananda camping entrance. The computer reduces survey data, to co-ordinate and plot a traverse line that can be overlain on a master plan. Each evening cavers queued to analyse their data in order to direct the following morning's push. Rapid survey plots were a considerable aid to exploration and the portability of the computer proved invaluable when used whilst track cutting to locate cave entrance shafts that had been found from the inside.

THUNDERUSH - trickles, torrents and trappings

Dragons Reach gave up its secrets easily with a dry pitch leading into a small sporting streamway, the Fruit Loop. The main water at the edge of the world was only temporarily avoided. Thunder Rush is beautiful but it clamours with the sounds of danger. "See my smooth cream rock. Look up high at my cleanwashed walls and listen to my stream as it plunges unrelentlessly down through millpools, swims, rapids and pitches", it is but whispering. The party that first explored Thunder Rush got warnings of things to come. The afternoon flood pulse hit. Two cavers in Fruit Loop headed for the roof and another in Thunder Rudh did the same. Two others near the bottom of Thunder Rush made their way out through the minor flood cleaning out the roof sitters as they went.

With 200m of rope down it Kananda Pugwa was already deeper than the Atea Kananda and still going strong. The Mamo Kananda and Kananda Pugwa camps engaged in friendly rivalry as one group extended its cave to 37km and claimed they had the longest cave in the world while the more modest were interested in obtaining the deepest cave in the Southern Hemisphere. Such discussions were made between camps on a single wire telephone system (Mitchie Phones).

As the push for depth continued in Kananda Pugwa a party of nine left for the bottom. The water in Thunder Rush was high so one turned back. A fast party pushed on through to the Doldrums. One was sick so he went out. Another got bored with surveying so he went out. THE RULE was: 'Survey What You Explore'. The party surveying in observed the curfew and got out. The party surveying back from the end persevered through the afternoon and evening and that day it rained. ..... and rained .....

All intercamp rivalry was forgotten. One team of four cavers was trapped in an upstream lead in Kananda Pugwa. They waited out the flood in a comfortable gypsum sand passage. In a slight lull they tackled a raging torrent only to get hit by a second pulse and had to sit it out in far less comfort for another six hours. They emerged on the surface after a 20 hour epic. Even more serious was the plight of the three conscientious surveyors trapped below the potentially lethal Thunderush. They had returned from their marathon surveying trip to find a raging wall of white water at the bottom of the last pitch in Thunderush. The day following the flood it rained consistently and although water levels dropped elsewhere, in Thunder Rush they barely changed. By the next day fears rose of their actually having been washed away by one of the flood pulses or at least being badly exposed. On the third day, an early start was made down the cave to effect the rescue before the afternoon rains. Overnight it had stopped raining long enough for the water to drop and allow Thunderush to become passable once again. The three were found safe and well until they were fed some instant energy food. Golden syrup and water is guaranteed to make even the most healthy caver keel over feeling sick in the stomach. 54 hours was the longest non-camping trip of the expedition and a personal record for Tony White who seems to make a habit of being trapped in flooded caves.

Life returned to normal with renewed enthusiasm to make up for the days lost during the rescue. The only difference was the rigid enforcement of a 2 p.m. return through Thunder Rush and other vadose streamways. This meant the unpleasantness of Alpine starts. At Kananda Pugwa there was a new healthy respect for pushing streamways for depth. For in the Doldrums, where the roof dipped to 2m above the water were fresh tide marks indicating that the water had backed up 10m during the last flood.

As the seriousness of the caving increased, people started to emerge from their underground homes onto the surface. To the north of Kananda Pugwa is doline Mamo VI (volume 25 x $10^{6}m^{-3}$ and it is one of the smaller dolines on the Muller). When examined it turned out to be what has become known on the Muller as too big for its own good. A hole to the south of it was full of nothing but rainbows and fresh air but did provide two days of sporting 110m descents to reach the cave entrance in its sides. Despite all this activity, one entrance was left for future explorers.

The maze of jungle covered dolines which make up the Mamo plateau surface has always presented a problem when trying to give the caves a location. But Kananda Pugwa was on a readily identifiable set of geological features and could be placed on the airphotos - its position was such that a more direct route back to Atea Base lay through the MULLER 76 area (MULLER 76 was a small expedition, largely of a reconnaissance nature). In one day of track cutting through light

forest full of flowers the 1976 camp was reached. If fates and resources had been somewhat kinder the secrets of Mamo would have been revealed some six years before. In 1976 we had turned back to put our meagre resources into the initial exploration of the Atea Kananda.

Our compensation was however the pit Malemuli found on this route. At first sight it could almost be placed in the too big category. While most cavers use the standard rock drop method to get an estimate of the depth of a shaft, New Guinea rainforests are a bit short on rocks. The Duna have solved this problem by the standard treedrop-chop-chop-chop-1,2,3,4,5,6 CRASH AIEE! 130m below a 30m tree becomes a mass of tooth picks. After a rubble slope. Pitch 2 was a six second drop (rocks this time!). 100m hanging 2m off the clean polished wall and then another 80m by a waterfall to a sump. Malemuli is 420m deep and there is still an entrance in its side waiting to be explored.

FRIDAY THE THIRTEENTH - we're not superstitious

In Kananda Pugwa another set of huge chambers had been encountered and the cave was 528m, the deepest three chambers over a million cubic metres of air space. On Black Friday a party was down trying to break this third blockage when over Mamo Kananda there was a cloud burst just before lunch. Down below cavers were running from place to place trying to avoid the flood-waters which were invading even the driest parts of the cave. A continuous commentary was being heard in the two camps as the Mitchie phones were being used to find out what the hell had happened on the surface and graphic descriptions of what was going on below, complete with the sounds of rushing waterfalls. The party at the bottom of Kananda Pugwa had no such luxury but they also had no flood. They got to the relative safety of Dragons Reach before the flood pulse hit. It came so rapidly and without warning that the dry pitch to Fruit Loop began to resemble the inside of a carwash in just minutes. They breathed a sigh of relief as they saw 0.5 m^3s^{-1} roar off down the narrow Fruit Loop. Most of this water was coming from a passage high in the wall of Dragons Reach.

In Mamo Kananda a passage had been found heading towards Kananda Pugwa. It contained several low, wet sections and also had a good go at consuming the people in it. Everybody was thought to have survived Black Friday until at Kananda when dinner was ready we noticed that one of our biggest eaters was missing. A party of three who in the morning had gone exploring upstream in the Kananda Pugwa sinking stream had not returned. The few who had been there could remember no "safe" areas, but once again luck was with us and the party were safely trapped in a newly discovered dry passage. To be caught in many sections of the Muller Caves as the flash floods come through would be fatal. Even the moderate afternoon rains cause pulses which makes some passages temporarily impassable. Even the cave spiders that live in these flood-prone passages have adapted by developing extra large claws for hanging on.

THE CONNECTION - or how to grow a bigger cave

Unlike the rest of Mamo Kananda "Friday 13th" passage goes downstream to the northwest straight towards Kananda Pugwa. A phone conversation established its co-ordinates. In Dragons Reach was just one passage in the right place and at the right level. Whether it went in the right direction was anyone's guess but it was the passage that the flood came out of on Friday 13th.

The passage was 8m up an overhanging wall and on the first inspection had been declared unclimable. However it was in the right place and at the right level. With a connection at stake (37km + 8km) it was worth another look. A rising traverse looked like the best way of climbing into it. Despite one severe backward step when the leader unzipped 3 pegs back to a bolt (the "peanut gallery" below it was great!), ten hours of climbing saw us up to the passage. A quick run along confirmed that it did really head southeast. At the same time a Friday 13th exploration party had been stopped by a 40m pitch.

Back on the surface the computer confirmed that the two passages were at suitable levels and 200m apart. Mamo Kananda sent a party to descend the 40m pitch and Kananda Pugwa a party to explore the passage from Dragons Reach. As hoped the Kananda Pugwits found a 40m aven 260m along their passage, with Mamo Kanandans at the top trying to throw a rope down. In almost no time Kananda Pugwa had grown by 900% or had Mamo Kananda scored an extra 8km and increased by 22% there are still some unbelievers of the latter.

To the last day Mamo Kananda continued to produce one kilometre of passage a day and each kilometre had leads to spare. As always depth on the Muller proved to be elusive, neither exploration in the hazardous depths or the search for higher entrances was fruitful. The caves had to be detackled - it was found that the saddest story of the expedition is of the party in Kananda Pugwa who in surveying their last kilometre on the last possible caving came upon a 30m pitch into a huge chamber which they assumed to be Dragons Reach because of its vastness. So they pulled up their ropes and returned to camp. Back on the surface again our by now well-worn computer was losing its mind - survey data phoned to Mamo Kananda had placed the end of the survey 150m from Dragons Reach but a quick check of the data confirmed computers never lie - Yes there is another big chamber out there AIEEE waiting!

AN EVALUATION - or where was the sex, drugs and rock and roll

Cave exploration in Papua New Guinea is both exhilirating and frustrating. The rewards are immense but achieving them is difficult. To date the Muller Range contains some 110km of spectacular cave passage, the deepest cave in PNG and the second deepest in the Southern Hemisphere and the 12th longest cave in the world. This list of achievements can be attributed to one or all of three things. The efficiency of the cave exploration, the great potential of the Muller Range as an area for caves or of course luck. Once again we had insufficient resources, there was sufficient manpower but often this lacked direction. Money was short - we spent $16,000.00 on helicopters with another A$10,000.00 we would have achieved more miracles.

It is not only having limited resources that makes Muller caving frustrating. Even before the expedition found its cumbersome way through the hassles of PNG bureaucracy we realised that conditions in this developing country were changing so rapidly that much of our pre-expedition planning and budgetting had been a futile exercise. Devious manipulations of available funds such as substituting a one hour flight for a one day open truck ride enabled us to give Muller 82 a balanced budget of approximately $150,000.00 - astonishing! Many telephone calls to Sydney and some inspired hardwork by the advance party lead by Steve Bunton ensured the first loads of gear and people arrived at a completed Atea Base on time. The expedition continued to run roughly to a very tight schedule - amazing!

It is the problems of organisation and re-organisation and continuous hassles increased in many ways by the size of the expedition that has led Al Warild to refer to Muller 82 as the last of the big expeditions. But no big expeditions means no sharing of costs. So in the future it will be the Muller for the rich and for those with lots of time and those prepared to take the extra risks involved by caving in the wet season. No-one died in the mighty floods that sweep through the caves - unbelievable! Mamo is one of the great caving areas of the future - it has depth potential and the length of its caves could be a contender for the Kentucky Caves. The rest of the Muller Range is still relatively untouched and the new contour maps show many regions that should produce both long and deep caves.

Oh yes - where was the sex, drugs and rock and roll? Well, they're all in the cave names so to find out about them you will have to read the book.

The cave now has three chambers with over a million cubic metres of airspace.

The helicopter was coming to take them away and the many metres of rope had to be rescued from the caves. The entrance ropes in both Mamo Kananda and Kananda Pugwa were worn out. They were 11mm and reputed to be the most abrasive resistant in the world. Although they were hanging free, the constant abseiling and prusiking, sometimes with muddy gear, had abraded the sheaf to an unsafe condition. But we had prusiked well over a 100km to find our 53km of cave a test for anyone's ropes.